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The biology and preimaginal morphology of Italian endemic species *Isturgia sparsaria* (Hübner, 1809) (Lepidoptera, Geometridae)

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Abstract. The geometrid species *Isturgia sparsaria* (Hübner, 1809) is restricted to Italy and its biology is unknown. Recently, several individuals of this species have been successfully reared in captivity. Experiments with various potential host plants are reported. The larva was reared successfully on *Genista tinctoria* L. and *Ulex europaeus* L. (both from family Fabaceae). Adult insects, as well as ovum, larva, and pupa are illustrated and/or briefly described.

Introduction

Genus *Isturgia* Hübner, 1823, with around 60 species, is mainly distributed in the Palaearctic, Afrotropical and Oriental Regions, and in Australia (Skou and Sihvonen 2015). Of these, 16 *Isturgia* species occur in Europe (Flamigni et al. 2007; Skou and Sihvonen 2015). In this genus, the biology and early stages of the Italian species *Isturgia sparsaria* (Hübner, 1809) (as well as of *I. punctistrigaria* (Christoph, 1897) and *I. messapiaria* (Sohn-Rethel, 1929)) were unknown (see Prout 1915; Wehrli 1940; Flamigni et al. 2007; Leraut 2009; Skou and Sihvonen 2015).

Isturgia sparsaria (Figs 1, 2) is a medium-sized geometrid moth (wingspan 24–28 mm). Wing colour pale straw, sprinkled with brown, with three brown lines, antemedial angled at costa, obsolescent medial, and postmedial; hindwing with postmedial line (see Flamigni et al. 2007 and Skou and Sihvonen 2015 for further morphological descriptions and diagnostic characters). It is an Adriato-Mediterranean species (corology after Hausmann 2001) endemic to Italy, in most of the Apennine mountain chain, Liguria, and Piedmonte (Skou and Sihvonen 2015).

Material and methods

On 7 June 2016, the third author collected a female specimen of *Isturgia sparsaria* in central Italy (Prov. Frosinone, ca. 1 km NW of Acuto, altitude 770 m, 13°09'57.97"E, 41°48'00.11"N).

A single female was attracted to a black light. It laid a total of 71 eggs in a small plastic box, with the bottom covered by toilet paper. Each egg was laid separately. During his holidays in Sardinia, the second author received the eggs from the third author in a plastic box. They were placed in a refrigerator (2°C) for five days to retard their development until he reached home and

could start his experiments. Most of the eggs were then kept in the refrigerator (2°C), but three were allowed to hatch at room temperature (22°C) in order to conduct experiments on host-plant preferences before allowing the remainder to hatch.

The tiny first instar larvae were housed in a small Polyethylene box (7.0×4.5×3.0 cm). They were offered a variety of food plants to see which plants were being accepted (this examination took eight days). Then, the larvae were transferred to the food plant. The first instar larva could always be recognised by the bigger head capsule in comparison with the body. After second–third ecdysis, the breeding was continued successfully in a cage (12×12×25 cm), which was covered with a screen-printing mesh, with the food plant in a small jar of water.

Results and discussion

Food plants and preimaginal stages. The second author successfully reared the larvae, after many experiments on food preferences (see below).

Food plant. Nearly all species of *Isturgia* feed on species of Fabaceae (Scoble and Krüger 2002; Flamigni et al. 2007; Skou and Sihvonen 2015). Based on this knowledge, the larvae were offered a wide variety of Fabaceae in our experiments, as well as species in other families (e.g. *Lonicera* sp.; *Artemisia* sp.; *Prunus* sp.) (see Table 1 for the complete list of all tested plants listed by family).

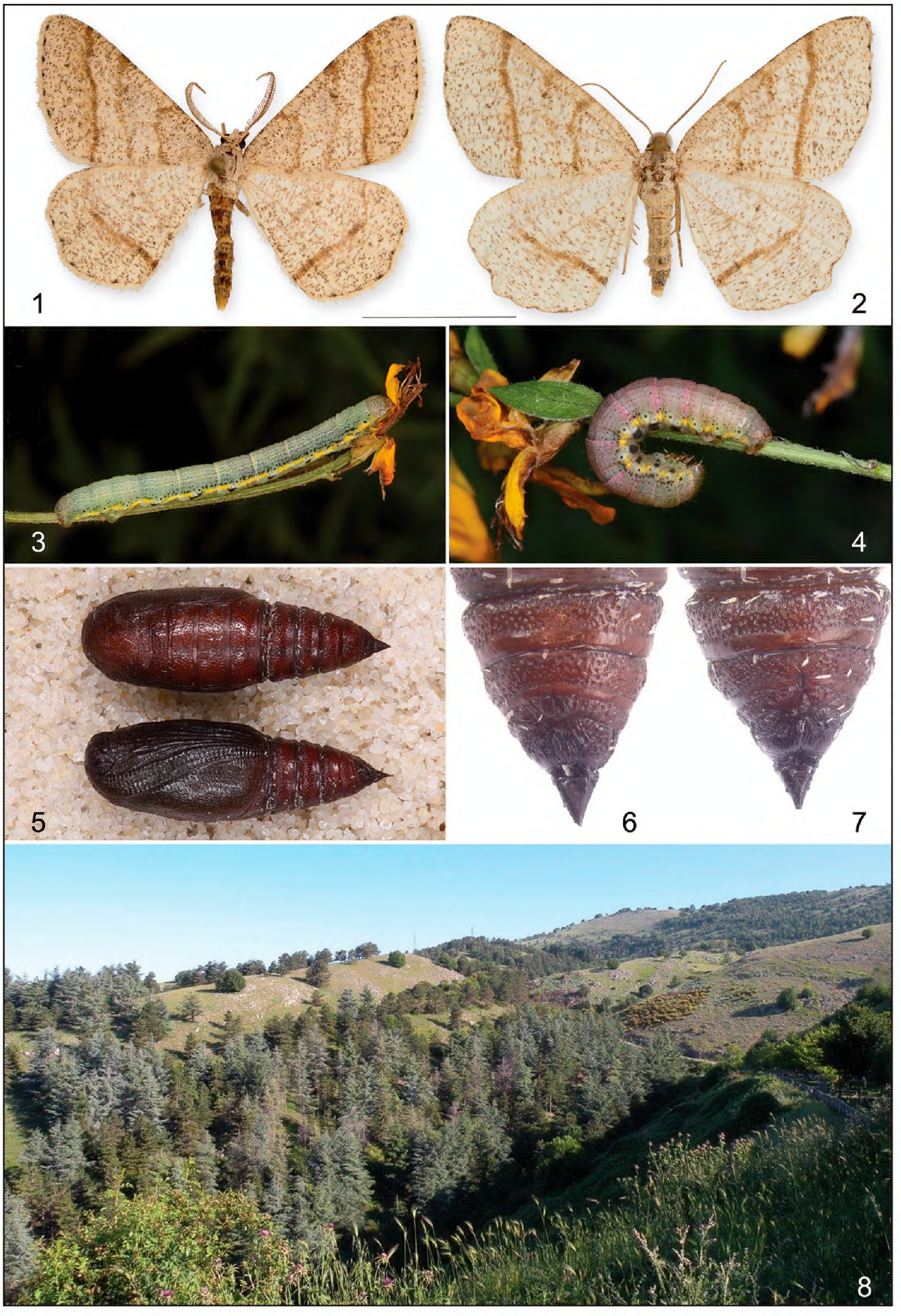
Preimaginal stages

Ovum. Elliptical, length about 0.75 mm, breadth about 0.45 mm. Freshly laid eggs dark grey-green, becoming violet-brown after two or three days. The eggs were attached dorso-ventrally to the substrate.

Larva. The first and second instar larva (L1 and L2) are more or less grey-green, without any characteristic colour pattern. The colour pattern appears gradually from L3 towards L5 (see below). The fifth instar (L5) (Fig. 3) is 35–45 mm long (n=6). Larval ground colour light turkey-green with scattered tiny dark dots; dorsal line is slightly darker, bordered on each side with a thin dark line; sub-dorsal and dorso-lateral lines slightly lighter than background, bordered by thin dark lines; lateral black spots, with higher concentration towards head capsule, form a disconnected black line, which becomes blurred in abdominal region; sub-lateral line yellow, ventrally with characteristic black spots, which are clearly visible on segments A3, A4, A5, and A6. Spiracles dark brown. Head white to light straw-coloured, with tiny dots. After 30–35 days and shortly before pupation, the fully-grown larva stops feeding and its ground colour changes to light pink or red-brown (Fig. 4).

Pupa. In total six larvae completed their development to the pupal stage. Pupa 10–11 mm long, fairly scabrous, red-brown in colour; wing case dark-green directly after pupation, gradually becoming dark-brown; punctures visible on 1st–8th abdominal segment (Fig. 5). Pre-pupal phase lasts four to six days in the soil, under laboratory conditions, and no cocoon was formed.

Results of this study indicate that the larvae feed largely on flowers or young soft leaves of *Genista tinctoria* and flowers or young soft spines of *Ulex europaeus* in captivity. It is likely that the hostplant of *Isturgia sparsaria* in the wild is also a species of Fabaceae. In the locality where the specimens were collected, *Spartium junceum* (Fabaceae) is quite common and is regarded as a potential hostplant of *I. sparsaria* in the wild, but this suggestion needs further study. According to



Figures 1–8. 1–6. *Isturgia sparsaria*. **1.** Male (Italy, Marche, Bolognola, 1100 m, Valle Fargno, 2.viii.2010, *leg*. Teobaldelli, in coll. M. Leipnitz). **2.** Female (Italy, Abruzzo, Majella, 450 m, Fara S. Martino, Valle del Fossato, 26.vi.2009, *leg*. N. Zahm, in coll. M. Leipnitz). **3.** Fifth instar larva (L5). **4.** Pre-pupal stage. **5.** Pupa. **6–7.** Pupal cremaster of male (**6**) and female (**7**). **8.** Habitat of *Isturgia sparsaria*, where female specimen was collected: Acuto (Italy, Prov. Frosinone, altitude 770 m). Scale-bar for Figs 1, 2: 1 cm.

Table 1. *Isturgia sparsaria* (Hübner, 1809): larval reactions to plants (listed by family) offered under captive conditions (botanic nomenclature according to The Euro+Med Plant Base: http://www.emplantbase.org/home.html).

Family: Plant species	**Larval reaction**
Fabaceae: *Lathyrus pratensis* L. - *Ononis spinosa* subsp. *procurrens* (Wallr.) Briq. (= *Ononis repens* L.) - *Cytisus scoparius* (L.) Link (= *Sarothamnus scoparius* (L.) W. D. J. Koch) - *Chamaecytisus purpureus* (Scop.) Link - *Genista sagittalis* L. (= *Genistella sagittalis* (L.) Gams) - *Medicago sativa* L. - *Trifolium campestre* Schreb. - *Dorycnium pentaphyllum* subsp. *germanicum* (Gremli) Gams (= *Dorycnium germanicum* (Gremli) Rikli) - *Lotus corniculatus* L. - *Astragalus alpinus* L. - *Securigera varia* (L.) Lassen (= *Coronilla varia* L.) - *Vicia sepium* L. - *Vicia sativa* subsp. *nigra* (L.) Ehrh. (= *Vicia angustifolia* L.) - *Vicia cracca* L.	Rejected
Fabaceae: *Genista tinctoria* L.	Accepted (Flowers, young soft leaves)
Fabaceae: *Ulex europaeus* L.	Accepted (Flowers and young soft spines)
Salicaceae: *Salix purpurea* L.	Rejected
Fagaceae: *Quercus robur* L.	Rejected
Rosaceae: *Prunus spinosa* L.	Rejected
Apiaceae: *Bupleurum falcatum* L.	Rejected
Lamiaceae: *Thymus vulgaris* L.	Rejected
Caprifoliaceae: *Lonicera tatarica* L.	Rejected
Compositae: *Artemisia alba* Turra (= *A. camphorata* Vill.)	Rejected

Flamigni et al. (2007), *I. sparsaria* reaches also higher altitudes (1300 m and 1600 m in the central and southern Apennines, respectively), where *S. junceum* does not occur. However, *Genista tinctoria* is widespread throughout the Apennine regions from sea level up to 1800 m.

It is also quite possible that the larvae of this species are polyphagous on other plants which occur in its habitat. In captivity, the larvae accepted two different genera of Fabaceae, but further field studies are necessary to confirm how host specific the larvae of this species are in the wild.

As the adult specimens of *Isturgia sparsaria* were observed on an oak, *Quercus* sp. (Worm-Hansen 1935), this tree was suggested as a potential hostplant (Flamigni et al. 2007). In our experiments, the larvae rejected *Quercus robur* and this tree is definitely not one of the hostplants.

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